Strategic Missile (Minuteman) Operating and Support Cost Factors

by

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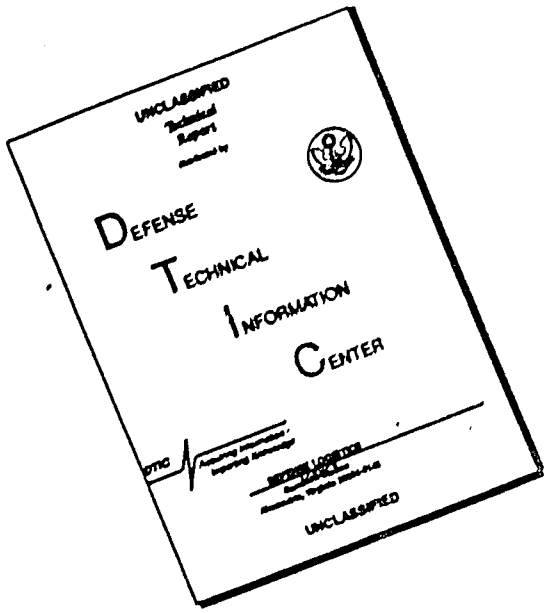

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EXECUTIVE SUMMARY

SECTION I

EXECUTIVE SUMMARY

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The objective of this special study was to review the spectrum of available cost models and cost studies addressing strategic missiles, evaluate the elements of cost pertaining to operation and support, establish a comprehensive cost element structure to serve as both a standard or checklist in accomplishing cost estimates and the basis from which to develop Air Force cost factors. And finally, actually develop operations and support cost factors for Air Force strategic missiles and make them available to the cost community through publication in AFR 173-13. This paper was presented at the annual DOD Cost Analysis Symposium.

The Air Staff needs a mechanism be able to respond to every-day time-contrained cost estimating exercises concerning typical squadron operating cost. Although HQ SAC has available an existing MACE (Missile Analysis Cost Estimating) model, its cost factors limit its effectiveness. Current, accurate cost factors are not always readily available, nor are they published for Air Force-wide application.

The Air Force inventory of existing strategic missiles includes approximately 1000 Minuteman and 50 Titans. Because the Titan fleet is old, small, and phasing out of existence, which in turn is accompanied by erratic and minimal cost expenditure, their cost and cost factors were not addressed. The scope of this study is limited to developing life cycle and budgetary cost factors for the Minuteman.

To the extent possible, development of cost factors was accomplished using existing cost data collected from the Defense Accounting Data Base (DADB) and the General Accounting and Finance System (GAFS) consolidated and maintained by the Air Force Accounting and Finance Center. Depot Maintenance costs were taken from the Weapon Systems Cost Reporting System (WSCRS) maintained by AFLC. In some instances, cost reports at the base or MAJCOM level were required to provide cost separation and identification at the weapon system level. Software support costs required the most intense cost collecting and allocation procedures. SAC SIOP costs had to be identified from contract data maintained by the Ballistic Missile Office (BMO), contract software development and maintenance needed to be separated from sustaining engineering costs at Hill and Kelly AFBs, and in-house depot and non-depot manning resources were identified at all three ALCs involved in missile component repair.

Cost data was collected, where available, for the period FY78 through FY83. Costs were then normalized to FY85 dollars to make comparative analysis possible. Evaluation using correlation and

regression analysis helped to validate and ascertain logical relationships between costs and system parameters or independent variables. Independent variables considered include the number of personnel authorized (officer/enlisted/civilian) by program element, the total number of missiles in the inventory, the number of missile silos, the number of missile months in a ready status, the number of operational tests, and the composite age of the fleet. Regression analysis involved linear and non-linear functions and considered combinations of independent variables. The functions for which the coefficient of determination was most significant were used to project budget costs in FY87. Costs over the expected 20 year life of the Minuteman were averaged to form life cycle cost factors. Where no relationships appeared to exist, historical average cost of available data was used for both life cycle and budgetary factors to smooth annual cost fluctuations.

The primary limitation of this factors development effort was the limited historical cost available. Most factor areas were developed with five year's historical data. Spares, support equipment, and Class IV modifications had only four years history. Operational test firing costs were available for only two years. Second destination transportation costs were only partially available for a two year period. Software support costs were estimated using a single year of data.

As a result of this special study, life cycle and budgetary cost factors have been developed for the Minuteman in seventeen cost categories and a new Strategic Missile Cost Estimating (STRAMICE) model has been developed to apply them. This represents an increase of eight new cost elements to those normally addressed by the MACE model. Budgetary factors are predictive in nature and tend to be significantly higher than MACE factors. Life cycle cost factors, on the other hand, are averages of costs incurred over the life of the Minuteman and are slightly lower than MACE factors.

Recommend a separate missile cost model and cost factors section within Chapter 7 of AFR 173-13 be established using the narrative and cost element descriptions provided. Separate tables could identify Minuteman life cycle and budgetary cost factors, STRAMICE model input information requirements, the STRAMICE cost model, and typical Minuteman squadron operating cost.

Missile cost factors development is not a one-shot effort, but a dynamic process of re-evaluation, growth, and refinement. Follow-on efforts are required to build a better cost factors data base to improve existing factors as well as to expand coverage to tactical and newly acquired strategic missiles.

SECTION II

BACKGROUND

BACKGROUND

The need driving this HQ USAF/ACMC tasking was based on requirements received at that level to prepare preliminary assessments of missile basing alternatives and to answer time-constrained "what-if" exercises concerning typical squadron operating cost and comparative costs to other and similar systems. Many of these requirements are currently met by tasking HQ SAC/ACM to execute the Missile Analysis Cost Estimating (MACE) model or by forming a cost analysis group to more extensively evaluate comparative or new system acquisition cost.

The SAC MACE model is an adequate cost estimating tool even though somewhat aged. Some, however, have begun to doubt its comprehensiveness and accuracy, perhaps through comparison of its cost projections with the results of more extensive cost analysis efforts. Update of MACE cost element factors is perhaps its weakest feature. Factors are updated as required or annually but may be updated by anticipated inflation (as opposed to specific factor development) for unexpected costing requirements. Logistics factors are developed at Hill AFB using the previous year's actual cost experience. As such, costs have predictive value only if they are relatively stable and consistent - an assumption not born out by closer inspection.

ASSUMPTIONS

SECTION III

ASSUMPTIONS

Because personnel cost is so dependent upon the maintenance concept involved and projected basing strategy, operations personnel cost factors were not created. Costs will be developed based upon HQ SAC/XPM price-out to portray the unique situation for the specific missile system.

Helicopter cost is a missile support cost element and should be addressed. Helicopters are, however, separate aircraft weapon systems and their operating costs are best estimated using the CORE model. Basing strategy and location for new missiles are important cost drivers in determining type and quantity of helicopters required for support.

Airborne Command Post (EC-135) costs are involved with missile operations, but are considered a separate weapon system. These costs are not recognized as a direct cost of operating the Minuteman system even though they are equipped to launch missiles in emergency situations. The possibility exists that, with a new or expanded basing concept, additional aircraft or flights may be required. These incremental costs should be considered on a case by case basis.

The Air Force installation support non-pay factor which estimates the non-personnel general base support, civil engineering, and communications materials and services cost per manpower authorization is appropriate for missiles. Utilities are included in this factor. Missile-unique installations support costs are separately addressed and charged to the Minuteman program element.

The cost of the Minuteman education program charged to EEIC 553, is a unique recruiting, morale, and retention incentive and not a required support cost of the system. These costs are excluded from the 'other contract services' cost factor per direction given during the July 1984 factors development review.

Operational TDY and per diem are not personnel costs as suggested by the OSD CAIG operating and support cost development guidelines. As a result of the July 1984 factors development review, Air Staff approved logical categorization of TDY and per diem as an 'other direct cost'.

To more comprehensively address relevant Minuteman operations and maintenance costs, the definition of both maintenance and operational materials is expanded to include expensed equipment as well as supplies and materials.

The Peacekeeper ICA assumed the life of the Peacekeeper to be twenty years. The Titan is phasing out and currently has an average composite life of 21+ years. It is assumed for the purposes of life cycle cost analysis that the Minuteman has an expected life of twenty years.

An observed tendency exists for weapon system operations and support costs to be high in the initial years of its life, to level off during mid-life, then to increase again as it nears the end of its life. This "bathtub curve" description of costs was used in developing depot maintenance and spares life cycle costs for the Minuteman.

METHODOLOGY

SECTION IV

METHODOLOGY

Before discussion of methodology used to develop missile cost factors, it's necessary to emphasize the importance of development of an appropriate cost element structure. One should not discuss development of components without knowing what the components of system cost are. An integral part of the review of the strategic missile cost element structure was initial Air Staff desire to go beyond the normal aircraft cost factors process and address a more total cost concept. Although personnel costs were not specifically addressed in cost factor form, most other operational costs are. With this in mind, immediate support of the missile involves not only peculiar support to the missile itself, but to the missile complex as well. Costs consider administration, civil engineering, communications and transportation as well as operations and maintenance.

Available studies by the Air Force, RAND, and other contractors were reviewed. Existing cost models (CORE, MACE, SABLE, and ESOM) and their cost elements were studied. The Peacekeeper ICA was ongoing at the time and provided a unique perspective on what cost elements the team considered relevant. Discussion with BMO personnel confirmed that costs they were considering were not very much different from cost categories addressed by the Peacekeeper ICA or those addressed by the MACE model. Differences tended toward more detail in support cost at base level and a more specific equipment requirements orientation. Requirements level analysis is too detailed for the higher order quick-response cost estimating model needed. One of the most helpful sets of documents reviewed was the various OSD CAIG draft guidance packages available for aircraft and missiles. These guides identified a wide spectrum of specific cost categories that might occur. Some categories however, do not necessarily exist as identifiable costs in the Air Force accounting system. In addition, some costs categories did not seem properly aligned in homogeneous groups or to the way the Air Force accounts for cost. For instance, one OSD CAIG guide categorized operational TDY and per diem cost (EEIC 4OX) as a personnel cost (EEIC 2XX or 3XX). Our ultimate alignment identified operational TDY and per diem as an 'other direct cost'.

The resultant cost element structure for strategic missiles started with existing MACE framework and expanded to cover those additional areas of costs that were separately identifiable within the Air Force accounting system. The following macro-level cost element structure was used to develop cost factors and serve as a basis of creating a new expanded missile cost model - STRAMICE (STRategic Missile Cost Estimating) model. A more detailed cost element structure is outlined in Section VII.

PERSONNEL

CONSUMABLES-FUEL	*added
CONSUMABLES-MAINTENANCE MATERIALS	
CONSUMABLES-OPERATIONAL MATERIALS	*added

DEPOT MAINTENANCE

SUSTAINING INVESTMENT - SPARES	
SUSTAINING INVESTMENT - SUPPORT EQUIPMENT	
SUSTAINING INVESTMENT - MODIFICATIONS	
SUSTAINING INVESTMENT - SOFTWARE	*added

OTHER DIRECT - OPERATIONAL TEST	
OTHER DIRECT - SUSTAINING ENGINEERING	*added
OTHER DIRECT - SECOND DESTINATION TRANSPORTATION	*added
OTHER DIRECT - LEASE	*added
OTHER DIRECT - OPERATIONAL TDY AND PER DIEM	*added
OTHER DIRECT - OTHER CONTRACT SERVICES	*added
OTHER DIRECT - AIRCRAFT SUPPORT-HELICOPTER	

INSTALLATION SUPPORT PERSONNEL

INDIRECT PERSONNEL SUPPORT

PCS

ACQUISITION AND TRAINING - ATC OFFICERS	
ACQUISITION AND TRAINING - ATC ENLISTED	
ACQUISITION AND TRAINING - CCTS(OFFICERS)	

As each cost element category was analyzed for available sources, emphasis was placed upon finding a readily available and firm data base. Those sources used by other factors development efforts were first reviewed. Two systems at the Accounting and Finance Center had available data; the DADB (Defense Accounting Data Base) and the GAFS (General Accounting Finance System). Cursory review indicated that these two systems could provide cost information concerning 10 of the expected 18 cost factor areas. Software and Second Destination Transportation (SDT) costs proved to be the most taxing cost elements, because these areas had no clear cut definition or identification within the accounting system. Ultimately software was identified at the ALC level. Five digit element of expense shreds of sustaining engineering identify portions of contract effort related to software maintenance. Organizational evaluation by the MM community at each ALC allowed them to identify manpower equivalents dedicated to hands-on software maintenance and development considering both in house DMIF and non-DMIF resources. SDT is charged to the 46X element of expense, but because parts and components are interchangeable within weapon systems and because logistics is

predominantly item managed as opposed to weapon system managed, no identity is given to the weapon systems involved. OO-ALC/DST does prepare budgetary estimates for movement of Minuteman missiles and major end items. But it does not, nor does anyone else, account for the bulk of repair and replacement parts and equipment transported to and from operational sites, depots, and procurement and storage points.

Costs were collected in then year dollars, which mask actual cost trends with the intertwining effects of inflation. Costs were converted to constant FY85 dollars for comparative and analytical purposes by applying inflation indices taken from Table 5-1, Raw Inflation Indices, and Table 5-2, Weighted Inflation Indices dated 1 February 1984, Base Year FY85, AFR 173-13. Only depot maintenance costs out of the WSCRS system came already adjusted for inflation.

Independent variables were identified as a means to analyze the collected cost data. These are parameters within the system's operation which drive or cause costs to occur at different levels. A logical cause and effect relationship between independent variables and cost was predicted for each cost element before analysis began. The number of missiles in the inventory, the number of personnel in the system, and the number of operational tests were thought to drive costs. Even though these three independent variables were all that were logically identified, all available independent variables were used in the initial analysis. However, the number of independent variables which were consistent and available without onerous amounts of effort was limited. HQ SAC reviewed the possibility of other independent predictive variables, but no others were readily available. The following are a complete list of available independent variables used:

Missile inventory
Number of-active missiles free from depot maintenance
Number of missile complexes or silos
Total Minuteman program element personnel
Minuteman Program element officer personnel
Minuteman Program element enlisted personnel
Total MM communications program element personnel
Minuteman communications officer personnel
Minuteman communications enlisted personnel
Total personnel
Total officer personnel
Total enlisted personnel
Missile composite age
Number of operational test launches

Missile inventory and missile composite age were obtained from the 30 September 1983 G033D microfiche, Aerospace Vehicle Inventory by serial number (within MDS). Number of missile silos and number of operational test launches were obtained from HQ SAC. The number of missiles free from depot maintenance (or average

operational active missiles) was taken from WSCRS reports. Personnel data was provided by HQ USAF.

Relationships between cost data and independent variables were analyzed with the aid of the AFAFC/CW time sharing statistical analysis system (TSO SAS). Factor areas were treated separately, regressing annual cost in terms of constant FY85 dollars against all independent variables for correlation. Analysis was made of coefficients of determinations (R^2) and degrees of variance to identify those relationships that were meaningful and reject those that were not. Cost data and linear functions of those variables which showed an R^2 of greater than .50 were graphed for visual analysis. Non-linear functions (log, inverse, quadratic, cubic and square root) were also submitted to statistical and graphical analysis. Combinations of independent variables were considered when two variables might appear to explain an increased proportion of the least squares variance from the projected function.

In most instances composite missile age appeared to be the best predictor of future cost having generally the highest R^2 values with acceptable variance (less than 20%). Other variables which were anticipated to have a logical relationship showed high correlation as well, but failed to logically predict the direction of cost change. For instance, personnel authorized for the Minuteman system have been declining over the past few years although total adjusted costs have been rising. This created a relationship with a negative slope which doesn't entirely make sense. Reduced numbers of personnel,for instance, should not cause fuel consumption to increase. The independent variable expected to drive most costs - Number of missiles - showed no correlation because costs were rising while the number of missiles remained constant or relatively constant. However, for the purpose of creating cost factors and relating missile costs to the missile fleet, all costs are allocated to the number of Minuteman missile silos.

Not all costs showed significant correlation with any of the independent variables evaluated. At least a partial explanation for this is lack of an adequate historical data base. In the case of Consumables - Maintenance Materials, Consumables - Operational Materials, Software, Second Destination Transportation, Lease, Operational TDY and Per Diem, and Other Contract Services, no relationships could be identified. For these elements, estimated costs were created using an average of available cost data. A horizontal straight line is used to represent the average cost curve as well as the life cycle cost curve. At any point on this curve, life cycle cost equals budgetary cost.

Other factor areas including POL, Support Equipment, and Operational Test were best estimated with simple linear regression. POL and Support Equipment were linear functions of the independent variable missile age. Operational Test was best

estimated using number of launches. The inverse function of missile age was the relationship used to create cost factors for Depot Maintenance, Spares, Modifications, and Sustaining Engineering.

Two of the highest cost and most important factor areas, Depot Maintenance and Spares, were evaluated in further detail. In the case of all other factors, life cycle costs in the period before costs were available, were assumed to be constant. Those costs were estimated to be at the level of the oldest or an average of first and second oldest data points, depending upon the magnitude and orientation of those points. The front end of both Depot Maintenance and Spares functions were reconstructed to follow a "bath tub" curve. This cost curve has been consistently observed in aircraft for the same factor areas. The bath tub curve reflects initial annual cost progression to be decreasing at a decreasing rate consistent with learning curve theory, to stabilize and level-off during mid-life, to increase at an increasing rate as the system becomes older, then to increase at a decreasing rate as cost, management, and political constraints come more into play. The slope of the initial learning curve down-side of the bathtub curve was projected to be the mirror image of the predicted values of the function fitted to the observed up-slope of increasing costs. Application of a bath tub curve to these factor areas tends to increase their life cycle costs because of the projected higher costs as the initial system is fielded. It has no effect on the projected budgetary factor.

Minuteman life cycle cost factors are summarized for the STRAMICE cost model in various tables of Section VII.

PROBLEMS & SOLUTIONS

SECTION V

PROBLEMS AND SOLUTIONS

Limited Data

Overall data availability ranged from one to six years. The Minuteman software maintenance and development factor was developed using one year's complete data. Because regression analysis used in the factors development process is so sensitive when small sample sizes are used, considerable fluctuation in projected factors is expected.

Limited data availability is a problem only time and expanded data bases can solve.

Second Destination Transportation

Second destination transportation expense can be a significant cost of missile operations and support. For example, at one point in the Peacekeeper ICA, second destination transportation cost made up over 7% of level off operations and support costs. The factor developed using OO-ALC/DSTME budget estimates for movement of Minuteman missiles and major components amounted to $3,867 life cycle cost per missile. This amount addresses only a fraction of the total second destination transportation expense and rendered the factor unacceptable to the Air Staff. Until costs can be broken out or tracked by weapon system, this cost element will have to be resolved and estimated on a case by case basis.

The VAMOSC cost tracking and information system is working to develop an algorithm which can manipulate the data resources it has access to, to allocate and estimate second destination transportation cost for a weapon system. VAMOSC, however, does not have near term plans to include strategic missiles in its data base.

Class IV Modifications

There is a discrepancy between the BPAC identification codes described in AFR 300-4 and those used by either HQ AFLC or BMO when recording modification procurement costs. HQ AFLC records all missile modification costs in a BPAC 219990. Normally the BPAC identifies the weapon system ,e.g. the Minuteman BPAC is 21133X. HQ AFLC then identifies the weapon system in the Material Program Code (MPC). In the case of the Minuteman, 2133 instead of 21133X. BMO uses the BPAC properly but does not follow the MPC descriptions. They use the MPC to distinguish contractors or identify reservation of funds handled by other organizations. Used as described above, normal codes do not specifically identify and separate Class V from Class IV modifications. Class V modifications do not necessarily have a MPC code of 10xx nor do Class IV modifications have MPC codes 2000. There is potential for incorrectly extracting modification costs from DADB records, although currently BMO handles Class V modifications and HQ AFLC deals with Class IV modifications.

Particular attention must be given to separation and identification of modification costs in future factor updates.

Operational Test

Operational test costs for the Minuteman were developed using costs collected against the Minuteman program element 11213 at Vandenberg AFB and at HQ SAC. Costs do not include expenses identified by narrative description in the Vandenberg Financial Plan, DD COMP (AR) 1092 as Minuteman launch related. These costs are charged to the 394th ICBM TMS - Training program element 11897, and may contribute to the HQ SAC CCTS costs. HQ SAC is working with Vandenberg AFB to review operational test costs and provide a consistent methodology to collect and update cost factors.

Recurring Factors Development

The update and availability of current missile factors to support the STRAMICE model is necessary for the model to begin to meet Air Force needs. Many portions of these missile factors require manual preparation and are time consuming.

To be able to both systematically provide current factors and at the same time minimize the drain of Air Force resources, a feasible schedule for updating missile factors needs to be developed.

Limited Scope

Developed factors address only the Minuteman. The breadth of available missile factors needs to be expanded to address all strategic missiles. The Peacekeeper and the GLCM should be added as soon as they enter the Air Force inventory. The scope also needs to be expanded to address tactical missiles as well.

CONCLUSION

SECTION VI

CONCLUSION

This study has broadly reviewed only one spectrum of strategic missile costs. Cost element structures have been reviewed and condensed into one more comprehensive than most, yet with foundation in areas of cost actually incurred on a recurring operational basis and available historically in Air Force accounting systems.

This cost element structure is not intended to be a panacea and checklist for detail system cost development, but a basis for most likely cost areas and guide for quick-response macro modeling.

The STRAMICE model which exemplifies this cost element structure has several advantageous features. First, it examines eight additional cost areas previously ignored, making it a more comprehensive cost model. Secondly, cost factors employed by STRAMICE have a firmer basis and commitment to be updated and reviewed periodically. Thirdly, these same cost factors are projections based on statistical and regression analysis. They are predictive in nature as regards budgetary factors and less volatile as life cycle costs. Combined, these attributes should enable improved cost estimates of missile-related non-personnel costs (personnel costs assumed equal).

The initial factors developed are not perfect and areas for improvement have been identified in Section VI.

STRAMICE MODEL

SECTION VII

The following definitions apply:

a. Unit Mission Personnel :

(1) Operations/crew. The cost of pay and allowances for the full complement of missile operations crew and Wing staff personnel required to operate the missile squadron or Wing. Personnel are sub-divided into officer, enlisted, and civilian categories.

(2) Maintenance. The pay and allowances for personnel performing on and off equipment missile maintenance in support of assigned missiles, support equipment, and unit level training devices.

(3) Munitions. The pay and allowances for personnel performing maintenance and service functions involving missile munitions and nuclear armaments.

(4) Communications. The pay and allowances for personnel performing maintenance upon missile communication systems.

(5) Security. The pay and allowances for personnel required for squadron (Wing) command forces and related administrative duties. Duties performed include entry control, close and distant boundary support, and security alert teams.

(6) Other Staff. The pay and allowances for other personnel assigned. It may include special civil engineering, transportation, or other personnel.

b. Unit Level Consumption

(1) Petroleum, oil, and lubricant (POL). The cost of ground fuels, missile propellants, and miscellaneous fuel, oil, and lubricants needed for unit operations for other than flying requirements.

(2) Maintenance Materials. The cost of expensed materials and equipment used in unit level maintenance. This includes reparable and non-reparable items that are not centrally managed with individual item reporting, such as transistors, capacitors, gaskets, fuses, and other bit and piece material. It excludes reparables procured from the stock fund which are included in the replenishment spares cost element.

(3) Operational Materials. The cost of expensed materials and equipment used by non-maintenance unit activities. Examples include teletype paper, magnetic tapes, assault communication wire, charts, maps, binoculars, clocks, etc.

c. Depot Level Maintenance. The cost of personnel, materiel, and contractual services required to perform maintenance or modification of missiles, components, and support equipment. Work is primarily performed at centralized repair depots and contractor repair facilities, but may also be accomplished by mobile repair teams. Categories of depot cost by type of repair and subsystem include missile (overhaul, frame, propulsion system); Operations support equipment, launcher, missile accessories; guidance system; communication and control, and payload system. Also included is installation of Class IV modification kits.

d. Sustaining Investment. The cost of procuring spares, Class IV modification kits and materials, support equipment as well as the cost of developing and maintaining computer software.

(1) Replenishment Spares. The cost of replenishing the inventory of spares and repair parts that are normally repaired and returned to stock. These items are primarily procured to replace losses due to condemnations. In addition, this cost may include procurement of stock levels that are not provided by initial spares procurement.

(2) Replacement Support Equipment and Spares. The cost of replenishing the inventory of support equipment that is needed to operate or support missiles, missile subsystems, and other support equipment. This includes replacements for support equipment funded under the peculiar support portion of missile procurement (if the missile is still in production) and under common support (if the missile is out of production or the support equipment is common to more than one type of missile). Initial support equipment funded as either common support equipment or peculiar support equipment is excluded.

(3) Modification Kits. The cost of Class IV modification kits for missiles, support equipment, and training equipment. These modifications address retrofit changes that are required to achieve an acceptable level of safety; overcome mission capable deficiencies, improve reliability or reduce maintenance costs. Excluded are those modifications that are undertaken to provide operational capability not called for in the original design or performance specifications.

(4) Software Support. The cost for contract and in-house computer software support required in the upkeep, modification or reprogramming of computer programs in the operational phase. It includes operational, maintenance, and diagnostic software programs.

e. Other Direct Costs. The costs of other relevant and significant operating and support or direct logistic requirements for the missile not specifically included in other cost elements.

(1) Sustaining Engineering. The cost of personnel and services to determine the integrity of materiel and services and to ensure and maintain operational reliability, to approve design changes, and to assure their conformance with established specifications and standards. Includes contract engineering and technical services of liaison, advice, and training concerning the installation, operation, maintenance, and logistical support of the missile. Engineering costs in support of software development and modification are excluded here as they are addressed separately within sustaining investment.

(2) Operational Test and Analysis. The cost for launch support (supplies and materials, ground fuels, expensed equipment, purchased maintenance of equipment, TDY travel and per diem) of operational test firing of missiles, range operations services and support, and evaluation and analysis of flight test data.

(3) Lease Costs. The cost of lease of commercial communication systems and networks, equipment, and passenger motor vehicles.

(4) Operational TDY Travel and Per Diem. The cost of operational TDY travel and per diem for administrative and mission support of the missile.

(5) Second Destination Transportation. The cost of transporting the missile, major missile end items, missile subassemblies, and components between depot maintenance facilities, operational units, and stock points. Includes the cost of moving missiles by air, rail, and ground to launch sites for operational tests.

(6) Helicopter Support Costs. The cost of personnel, materials, and services required to provide helicopter surveillance and emergency transportation between host base, launch, and launch control facilities. Costs can be estimated using the Core model and standard helicopter operations and support costs available in AFR 173-13.

(7) Other Contract Services. The costs of services not addressed elsewhere. Considers purchased maintenance of equipment, contract ADP services, contract logistics support, and miscellaneous contract services in support of missile operations and maintenance.

f. Installation Support Personnel. Same as aircraft systems.

g. Indirect Personnel Support. Same as aircraft systems.

h. Acquisition and Training.

(1) Officer Personnel. The Weighted Average Cost of formal skills training provided to primary program element and support officer personnel assigned to the missile system. Cost includes acquisition and basic military training.

(2) Enlisted Personnel. The Weighted Average Cost of formal skills training provided to primary program element and support enlisted personnel assigned to the missile system. Cost includes acquisition and basic military training.

(3) Combat Crew Training Squadron. The cost of missile-unique formal training provided by SAC to missile crew members.

STRAMICE MODEL INPUT INFORMATION (FY85 Dollars)

CODE	DESCRIPTION	AFR 173-13 Table/ Factor/Other Source
I. Program Factors		
F1	PAA	Command Input
II. Manpower Factors		
F2	PPE Officers	F5+F8+F11+F14+F17+F20
F3	PPE Enlisted	F6+F9+F12+F15+F18+F21
F4	PPE Civilian	F7+F10+F13+F16+F19+F22
F5	Operations/Crew Officers	Command Input
F6	Operations/Crew Enlisted	Command Input
F7	Operations/Crew Civilian	Command Input
F8	Maintenance Officers	Command Input
F9	Maintenance Enlisted	Command Input
F10	Maintenance Civilian	Command Input
F11	Munitions Officers	Command Input
F12	Munitions Enlisted	Command Input
F13	Munitions Civilian	Command Input
F14	Communications Officers	Command Input
F15	Communications Enlisted	Command Input
F16	Communications Civilian	Command Input
F17	Security Officers	Command Input
F18	Security Enlisted	Command Input
F19	Security Civilian	Command Input
F20	Other Staff Officers	Command Input
F21	Other Staff Enlisted	Command Input
F22	Other Staff Civilian	Command Input
F23	BOS Officers	Command Input
F24	BOS Enlisted	Command Input
F25	BOS Civilian	Command Input
F26	RPM Officers	Command Input
F27	RPM Enlisted	Command Input
F28	RPM Civilian	Command Input
F29	MED Officers	Command Input
F30	MED Enlisted	Command Input
F31	MED Civilian	Command Input
F32	Officer Pay	Table 3-5 AFR 173-13
F33	Enlisted Pay	Table 3-5
F34	Civilian Pay	Table 3-10

III. Program Support Factors/PAA

F40	Consumables-Fuel/POL	Table 7-5
F41	Consumables-Maintenance Materials	Table 7-5
F42	Consumables-Operations Materials	Table 7-5
F43	Depot Maintenance	Table 7-5
F44	Replenishment Spares	Table 7-5
F45	Support Equipment	Table 7-5
F46	Class IV Modifications	Table 7-5
F47	Software Support	Table 7-5
F48	Operational Test and Analysis	Table 7-5
F49	Operational Test and Analysis/Ops Test Launch	Table 7-5
F50	Sustaining Engineering	Table 7-5
F51	Lease	Table 7-5
F52	Operational TDY Travel	Table 7-5
F53	Other Contract Services	Table 7-5
F54	Officer Weighted Average System Training Factor	Table 7-5
F55	Enlisted Weighted Average System Training Factor	Table 7-5
F56	CCTS Training Costs	Table 7-5

IV. Common Factors

F60	Non-Rated Officer Turnover	.065
F61	Enlisted Turnover	.120
F62	Installations Support Non-Pay	$ 5030 or ($1819 x Authorized Military)+ ($ 2.60x 1^35 sq ft per person x authorized military)
F63	Officer PCS (CONUS)	Table 3-7
F64	Enlisted PCS (CONUS)	Table 3-7
F65	Officers, Med Non-Pay	$758
F66	Enlisted, Med Non-Pay	$758
F67	Officer Acquisition	Table 3-1
F68	Enlisted Acquisition	Table 3-1
F69	Officer Training Factor	$9188
F70	Enlisted Training Factor	$7767

V. Depot Maintenance

F80	Missile (Overhaul,Frame, Propulsion system)	CER
F81	Operations Support Equip, Launcher, Msl Accessories	CER
F82	Guidance System	CER
F83	Communication and Control	CER
F84	Payload System	CER

VI. Miscellaneous Factors

F90	Second Destination Transportation	Command Input
F91	Aircraft Support Costs	CORE Model
F92	Number of Operational Test Launches	Command Input

Strategic Missile Cost Estimating (STRAMICE) Model.

COST ELEMENT	ALGORITHM	EXAMPLE (LGM-30) FY 85$	TOTALS (MILLIONS)
1. Unit Mission Personnel			
1.1 Operations/Crew			
1.1.1 Military	F5xF32+F6xF33	78 x $51,245 + 31 x $22,927	$4.708
1.1.2 Civilians	F7xF34	1 x 26,183	.026
1.2 Maintenance			
1.2.1 Military	F8xF32+F9xF33	8 x 51,245 + 119 x 22,927	3.138
1.2.2 Civilian	F10xF34	1 x 26,183	.026
1.3 Munitions			
1.3.1 Military	F11xF32+F12xF33	1 x 51,245 + 10 x 22,927	.281
1.3.2 Civilian	F13xF34	0 x 26,183	.000
1.4 Communications			
1.4.1 Military	F14xF32+F15xF33	1 x 51,245 + 52 x 22,927	1.243
1.4.2 Civilian	F16xF34	5 x 26,183	.131
1.5 Security			
1.5.1 Military	F17xF32+F18xF33	5 x 51,245 + 226 x 22,927	5.438
1.5.2 Civilian	F19xF34	0 x 26,183	.000

1.6 Other Staff			
1.6.1 Military	F20xF32+F21xF33	0 x 51,245 + 0 x 22,927	.000
1.6.2 Civilian	F22xF34	0 x 26,183	.000
2. Unit Level Consumption			
2.1 Fuel/POL	F1xF40	50 x 3,023	.151
2.2 Maintenance Materials	F1xF41	50 x 9,354	.468
2.3 Operations Materials	F1xF42	50 x 4,861	.243
3. Depot Maintenance(1)			
3.1 Missile Overhaul,frame propulsion system	F1xF80		
3.2 Operations Spt Equipment, Launcher, Msl Accessories	F1xF81		
3.3 Guidance and Control Sys	F1xF82		
3.4 Communication & Control	F1xF83		
3.5 Payload System	F1xF84		
4. Sustaining Investment			
4.1 Replenishment Spares	F1xF44	50 x 35,104	1.755
4.2 Replacement Support Equipment	F1xF45	50 x	
4.3 Class IV Modifications	F1xF46	50 x 25,957	1.298
4.4 Software Support	F1xF47	50 x 26,018	1.301

5. Other Direct Costs			
5.1 Operational Test & Analysis[2]	F1xF48	50 x 14,718	.736
5.2 Sustaining Engineering	F1xF50	50 x 27,126	1.356
5.3 Lease	F1xF51	50 x 1,326	.066
5.4 Operational TDY Travel	F1xF52	50 x 894	.045
5.5 Second Destination Transportation	F1xF90		
5.6 Helicopter support	Throughput from CORE model		.571
5.7 Other Contract Services	F1xF53	50 x 1,538	.077
6. Installation Support Personnel[3]			
6.1 Base operating support			
6.1.1 Military	F23xF32+F24xF33	2 x 51,245 + 62 x 22,927	1.524
6.1.2 Civilian	F25xF34	17 x 26,183	.445
6.2 Real Property Maintenance			
6.2.1 Military	F26xF32+F27xF33	0 x 51,245 + 2 x 22,927	.046
6.2.2 Civilian	F28xF34	2 x 26,183	.052
6.3 Medical			
6.3.1 Military	F29xF32+F30xF33	1 x 51,245 + 4 x 22,927	.143
6.3.2 Civilian	F31xF34	1 x 26,183	.026

7. Indirect personnel support			
7.1 Installation Spt non-pay	(F2+F3+F23+F24+F26 +F27+F29+F30) xF62	(93+438+2+62+0+2+1+4) x4697	2.828
7.2 Med O&M non-pay			
7.2.1 Officer	(F2+F23+F26+F29) xF65	(93+2+0+1) x 758	.073
7.2.2 Enlisted	(F3+F24+F27+F30) xF66	(438+62+2+4) x 758	.384
7.3 PCS			
7.3.1 Officer	(F2+F23+F26+F29) xF63	(93+2+0+1) x 1172	.113
7.3.2 Enlisted	(F3+F24+F27+F30) xF64	(438+62+2+4) x 451	.228
8. Acquisition and Training			
8.1 Off Weighted Avg System Acq and Trng Cost (4)	(F2+F23+F26+F29) xF54	(93+2+0+1) x 1,295	.124
8.2 Enl Weighted Avg System Acq and Trng Cost (4)	(F3+F24+F27+F30) xF55	(438+62+2+4) x 2,112	1.069
8.3 CCTS	F5xF56xF60	78 x 55,007 x .065	.279

(1) When detail algorithms are not available,

3. Depot maintenance	F1xF43	50 x 48,403	2.420

(2) When operational test launches are a variable under consideration for change,

5.1 Operational test and analysis	F49xF92

(3) When indirect support personnel are not available, estimate SAC support personnel as follows:

F23=.0028x(F2+F3+F4)
F24=.1230x(F2+F3+F4)
F25=.0321x(F2+F3+F4)
F26=0
F27=.0035x(F2+F3+F4+F23+F24+F25)
F28=.0035x(F2+F3+F4+F23+F24+F25)
F29=.0024x(F2+F3+F23+F24+F27)
F30=.0071x(F2+F3+F23+F24+F27)
F31=.0019x(F2+F3+F23+F24+F27)

(4) When weighted average system acquisition and training cost factors are not available,

8.1 Acquisition		
8.1.1 Officer	(F2+F23+F26+F29)xF60xF67	
8.1.2 Enlisted	(F3+F24+F27+F30)xF61xF68	
8.2 Specialty Training		
8.2.1 Officer	(F2+F23+F26+F29)xF60xF69	
8.2.2 Enlisted	(F3+F24+F27+F30)xF61xF70	
	TOTAL	$32,688

STRAMICE
Typical Operating and Support Costs
(FY 85 Dollars)

CODE	DESCRIPTION	MINUTEMAN LIFE CYCLE INPUT FACTORS
F1	PAA	50
F2	PPE - Officer	93
F3	PPE - Enlisted	438
F4	PPE - Civilian	7
F5	Ops/Crew - Officer	78
F6	Ops/Crew - Enlisted	31
F7	Ops/Crew - Civilian	1
F8	Maintenance - Officer	8
F9	Maintenance - Enlisted	119
F10	Maintenance - Civilian	1
F11	Munitions - Officer	1
F12	Munitions - Enlisted	10
F13	Munitions - Civilian	1
F14	Communications - Officer	0
F15	Communications - Enlisted	52
F16	Communications - Civilian	5
F17	Security - Officer	5
F18	Security - Enlisted	226
F19	Security - Civilian	0
F20	Other Staff - Officer	0
F21	Other Staff - Enlisted	0
F22	Other Staff - Civilian	0
F23	BOS - Officer	2
F24	BOS - Enlisted	62
F25	BOS - Civilian	17
F26	RPM - Officer	0
F27	RPM - Enlisted	2
F28	RPM - Civilian	2
F29	Medical - Officer	1
F30	Medical - Enlisted	4
F31	Medical - Civilian	1
F32	Officer Pay	$51,245
F33	Enlisted Pay	$22,927
F34	Civilian Pay	$26,183
F40	Fuel/PAA	$3,022
F41	Maintenance Material/PAA	$9,345
F42	Operations Material/PAA	$4,861
F43	Depot Maintenance/PAA	$48,403
F44	Replenishment Spares/PAA	$35,104
F45	Support Equipment/PAA	N/A
F46	Class IV Modification/PAA	$25,957
F47	Software Support/PAA	$26,018

F48	Operational Test and Analysis/ PAA	$14,718
F49	Operational Test and Analysis/ Launch	$1,161,995
F50	Sustaining Engineering/PAA	$27,126
F51	Lease/PAA	$1,327
F52	Operational TDY Travel/PAA	$894
F53	Other Contract Services/PAA	$1,538
F54	Off Weighted Avg Acquisition and Trng/PAA	$1,295
F55	ENL Weighted Avg Acquisition and Trng/PAA	$2,112
F56	CCTS/Graduate	$55,007
F60	Non-Rated Officer Turnover	.065
F61	Enlisted Turnover	.120
F62	Installations Support Non-Pay	$4697
F63	Officer PCS (CONUS)	$1,172
F64	Enlisted PCS (CONUS)	$451
F65	Officer, Med Non-Pay	$758
F66	Enlisted, Med Non-Pay	$758
F67	Officer Acquisition	$43,118
F68	Enlisted Acquisition	$3,200
F69	Officer Specialty Training	$9,118
F70	Enlisted Specialty Training	$7,767
F91	Aircraft Support Costs	CORE

STRAMICE

MISSILE OPERATIONS AND SUPPORT COST(FY85 Dollars in Millions)

MDS	LGM-30
MAJCOM	SAC
Unit Mission Personnel	$14.991
Unit Level Consumption	.862
Depot Maintenance	2.420
Sustaining Engineering	4.354
Other Direct Costs	2.851
Installation Support Personnel	2.236
Indirect Personnel Support	3.626
Acquistion and Training	1.348
TOTAL	$32.688